

A Microphysical Model of CO₂ Snow on Mars

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Atmospheric condensation of CO₂ is a critical but poorly understood part of the Martian seasonal CO₂ cycle. During polar night, the latent heat released by CO₂ condensation is the major heat source, and CO₂ clouds can substantially reduce the infrared emission from the condensing seasonal CO₂ polar cap. The CO₂ snow which precipitates from the atmosphere may also help determine the radiative and physical characteristics of the seasonal CO₂ polar caps, depending on the relative amount of condensation which takes place in the atmosphere. Previous models of atmospheric CO₂ condensation on Mars have not taken into account the finite rates of nucleation, growth, and sedimentation, or the radiative effects of the CO₂ clouds themselves, and their results may be inconsistent with available data.

In order to address these issues, we have developed a one-dimensional model of the growth and precipitation of CO₂ snow in the polar night atmosphere of Mars. The model includes a realistic treatment of the microphysical processes of heat and mass transfer in both the continuum and free molecular regimes, as well as the transition region. We have also taken into account surface kinetics, or the finite rate at which molecules can be incorporated into the crystal lattice. We will present model calculations of snow particle growth and sedimentation rates for different values of atmospheric supersaturation and nucleation height. These results are compared with Viking IRTM observations to place constraints on the amount of atmospheric condensation. We will also present predictions of what TES and MOLA will see on Mars Global Surveyor.

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